

### ACCUMULATOR FUEL SYSTEM

[0001] The present invention relates to an accumulator fuel system use in an internal combustion engine, and in particular to an accumulator fuel system in the form of a common rail fuel system.

[0002] Accumulator-type fuel systems have an accumulator fuel volume for receiving fuel at high pressure and for delivering high pressure fuel to at least one of the injectors of the engine. Such systems are often referred to as common rail fuel systems and provide advantages for compression ignition internal combustion engines due to their flexibility and adaptability to engines of different type. Additionally, the pump requirement of the engine may be satisfied using just one high pressure fuel pump for supplying the common rail fuel volume, as opposed to an individual pump being required for each injector. The drive torque for common rail systems is also relatively low due to the ability to store energy within the rail fuel volume.

[0003] It is a disadvantage of common rail fuel systems that the common rail housing defining the rail volume occupies a large accommodation space within the engine. The rail housing is typically a forged part formed from steel and often must have relatively thick walls to withstand the high fuel pressures inside. The rail housing is therefore a relatively heavy and costly feature of the engine.

[0004] It is an object of the present invention to provide an accumulator fuel system which addresses the aforementioned problems.

[0005] According to a first aspect of the invention, there is provided an accumulator fuel system for use in an internal combustion engine having a plurality of engine cylinders, the fuel system including an accumulator fuel volume for supplying high pressure fuel to one or more of a plurality of injectors, each of which is arranged to deliver fuel to an associated one of the engine cylinders, wherein the accumulator fuel volume is integrated within an engine component which provides a purpose other than that solely of an accumulator fuel volume.

[0006] In one preferred embodiment, the fuel system includes a rocker shaft upon which a rocker member is pivotally mounted, wherein the rocker member is arranged to control one or more inlet and/or exhaust valves of an associated engine cylinder and wherein the accumulator volume is integrated within the rocker shaft.

[0007] In other words, the accumulator fuel volume (common rail fuel volume) forms an integral part of the rocker shaft as it is defined by an internal volume of the shaft. The rocker shaft therefore provides two functions; a shaft for supporting pivotal movement of a rocker arm and an accumulator fuel volume.

[0008] It is thus an advantage of the invention that an existing engine component (e.g. the rocker shaft) defines the common rail fuel volume for high pressure fuel, thereby avoiding the need for a separate large and heavy forged common rail housing.

[0009] It is a further advantage of defining the common rail fuel volume within the rocker shaft that the rocker shaft can be mounted conveniently and securely to the engine cylinder head and, thus, vibration of the common rail fuel volume, which is defined with it, is minimised.

[0010] The accumulator fuel system may be of the hybrid unit injector-common rail type, in which a high pressure fuel pump supplies fuel to the accumulator volume within the rocker shaft at a first pressure level, and wherein the system also includes the plurality of injectors, each injector including an additional pumping plunger for pressurising fuel that is supplied from the accumulator fuel volume to the injector to a second pressure level higher than the first pressure level. Such systems provide the advantage that injection can be achieved at one of two levels, thereby providing benefits for the injection characteristic.

[0011] Alternatively the accumulator fuel system may be of the type in which a high pressure fuel pump supplies fuel to the accumulator fuel volume within the rocker shaft and delivers fuel to the injectors directly for injection of fuel at rail pressure. In this case each injector may include a piezoelectric or electromagnetic nozzle control valve for controlling injection, but does not have its own dedicated pumping plunger.

[0012] In a particularly preferred embodiment, the rocker shaft is provided with a first rocker member for controlling one or more engine cylinder inlet valves, a second rocker member for controlling one or more engine cylinder exhaust valves and a third rocker member for transmitting drive to the pumping plunger of an associated injector.

[0013] More preferably, the rocker shaft has a longitudinal axis which is arranged to extend substantially perpendicular to a longitudinal axis of a pumping plunger of one or more of the injectors.

[0014] In another preferred embodiment the cylinder head itself defines the accumulator fuel volume. The cylinder head is a conventional part of existing engine installations mounted above the combustion chambers and upon which other fuel system components, such as the injectors and the inlet and exhaust valve components, are mounted.

[0015] The aforementioned preferred and optional features of the invention may also be provided with an engine cylinder head rail volume.

[0016] According to a second aspect of the invention, there is provided an accumulator for use in an accumulator fuel system, wherein the accumulator includes a rocker shaft or an engine cylinder head having an internal volume which defines the accumulator fuel volume.

[0017] It will be appreciated, therefore, that the invention is intended to relate to the accumulator component of the fuel system itself, as well as to a fuel system incorporating an accumulator volume and other fuel system parts.

[0018] The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

[0019] FIG. 1 is a sectional view of one embodiment of the accumulator fuel system of the present invention, in the form of a common rail fuel volume defined within an engine rocker shaft, and

[0020] FIGS. 2 and 3 are sectional views to show two alternative locations for the common rail fuel volume within the rocker shaft of the fuel system in FIG. 1.

[0021] The accumulator fuel system of the present invention is intended for use as a common rail system in which a